PAPERS AND PROCEEDINGS OF THE ROYAL SOCIETY OF TASMANIA, VOLUME 89

The Permian Rocks of Woody Island, Tasmania

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(WITH 2 TEXT FIGURES AND 1 PLATE)

ABSTRACT

The Permian section at Woody Island, Tasmania, begins with a pyritic siltstone, passes upwards through glendonitic, pyritic sandstone, siltstone and sandstone, tillite. siltstone and sandstone, a thin bed of bryozoal limestone and finally into a fossiliferous siltstone tentatively correlated with the Porters Hill Siltstone at Sandy Bay and the Bundella Mudstone at Mt. Nassau. The seventeen units, referred to nine formations, total about 330 feet and are considered to be Sakmarian and Lower Artinskian. The section is well-exposed in cliffs and on a shore platform developed just below high tide mark. A fault striking north-west and down throwing at least 260 feet to the east cuts the island.

INTRODUCTION

A visit by M. L. Yaxley to the island in 1953 showed that a good Permian section was exposed there and this was subsequently measured by all three authors. The island, situated about half a mile off Alonnah, Bruny Island, in D'Entrecasteaux Channel, has an area of about 70 acres and a height of about 120 feet. It is rimmed by cliffs up to 50 feet in height and a shore platform up to 20 yards wide at low tide. The only previously published report on the geology of Woody Island is by Scott, Roberts and Hobbs (1861) which mentions limestone on Satellite (Woody) Island.

We are greatly indebted to Mr. George Dibbern, owner of the island, for his hospitality during the visits.

PHYSIOGRAPHIC NOTES

The island has a gently rolling surface from about 50 to 120 feet above sea-level. Drainage from it is poor due to the relatively impermeable siltstones. What valleys are present are joint controlled or along the fault which intersects the island. The weathering is deep and produces clayey podzolic soils of which some are very pale. The fault acts as a passage for groundwater as evidenced by the seepages where it intersects the cliffs.

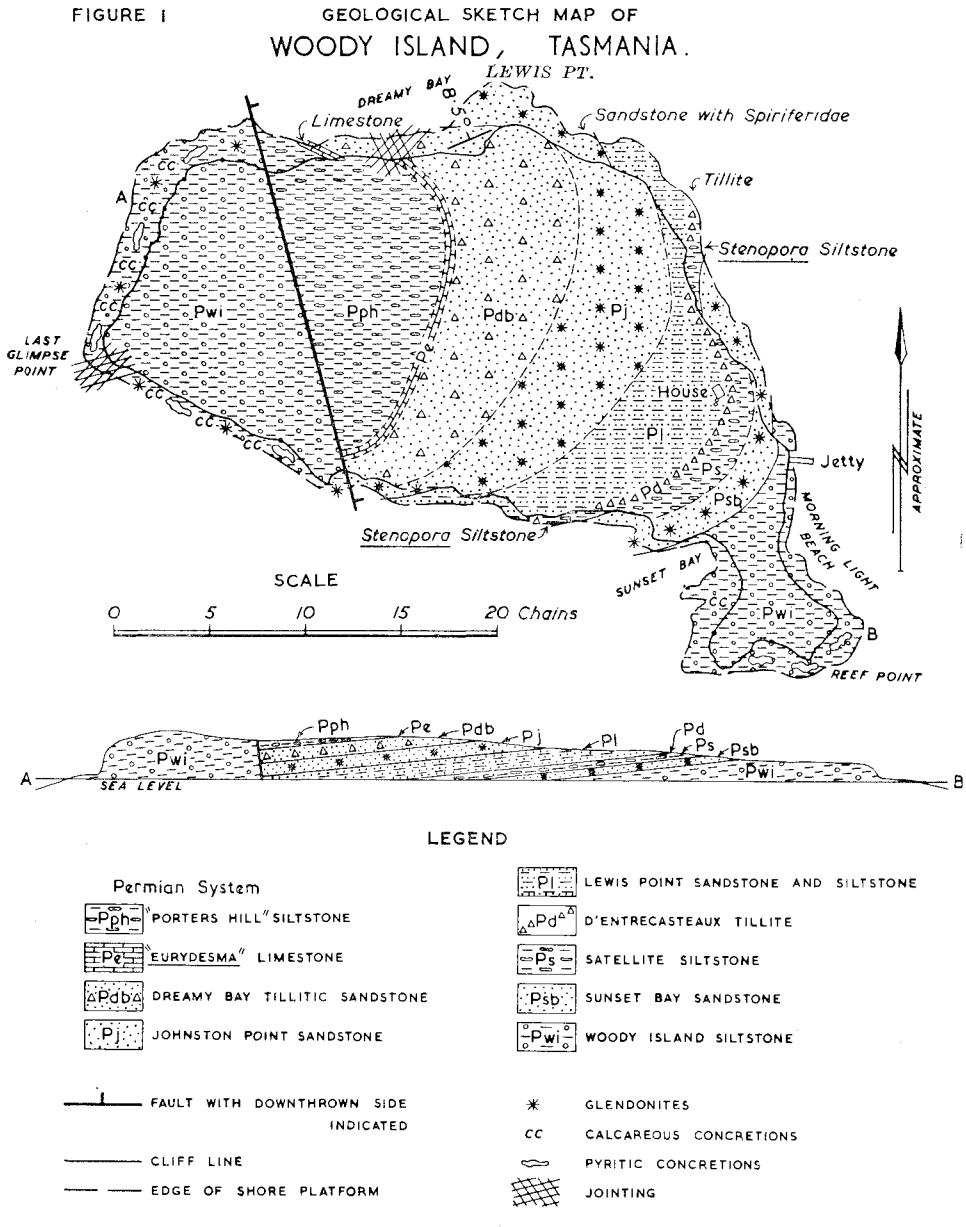

FIG. 1.—Geological Map and Section of Woody Island.

The Topographic Nomenclature Board ruled that Johnston Point be replaced by Lewis Point as another Johnston Point exists. The Johnston Point Sandstone of this paper is here renamed Alonnah Sandstone.

Steep cliffs have been developed by marine undercutting in the soft sediments and the cliffs are almost everywhere flanked by a wave-cut platform which is just flooded at high tide. The platform is interrupted by joint-controlled chines, by fallen blocks, and, at the western end of the island, by undercut masses of calcareous concretions, slightly more resistant than the enclosing siltstones. Landslips occur in the clayey soils in several places. The island is being actively eroded by the sea at the present time, the only depositional features being small pocket beaches of shingles.

Permian Rocks

The island is composed entirely of rocks of Permian age, good sections being exposed from the eastern end to the fault which roughly bisects the island. A sketch geological map of the island is included as fig. 1 and the succession is summarised in columnar form in fig. 2. Essentially the section is siltstone and sandstone with two tillitic bands and a thin bed of limestone. Seventeen units were measured but these could be grouped for mapping and description into nine formations.

Woody Island Siltstone

The Woody Island Siltstone is that formation of pyritic siltstone at least 86 feet thick as exposed on the eastern end of Woody Island where it is overlain by the Sunset Bay Sandstone. The underlying formation is not exposed. The formation contains *Eurydesma cordata*, crinoid columnals, and worm burrows. Its age is considered to be Sakmarian.

The lower member of this formation as exposed at the eastern end of the island is 73 feet thick and consists of blue-grey siltstone with rare erratics of quartz and quartzite and rare marine fossils. Bedding is thick to very thick but the rock breaks easily but irregularly into small blocks. Concretions of pyrite are very common. They are irregular in shape and orientation but there is a preference for elongation perpendicular to the bedding. Concretions of calcite up to twelve feet in diameter are also common and are lenticular with the greatest diameter parallel to the bedding. In places they contain small disarticulated crinoid columnals and some of them, when viewed from a distance, show rough cross-bedding. Large lenticular concretions, apparently of siltstone, with marked concentric fissility are also present in the cliffs at the eastern end of the island. Another feature of interest is the occurrence of alum efflorescence on the cliffs cut in this member. This would be the result of the attack of sulphuric acid, from the oxidation of the pyrite, on the clay minerals in the siltstone. The fossils in this lower member include small individuals of *Eurydesma cordata* but fossils are rare.

The upper member of this formation east of the fault is a well-sorted, yellow to white, siltstone with rare erratics of aplite and rare pyritic concretions. Worm tracks and burrows are common in this member and a few small pelecypods also occur. It is finely cross-bedded. Arrowhead markings in this member probably represent infilling of worm burrows.

FIGURE 2 COLUMNAR SECTION OF PERMIAN ON WOODY ISLAND

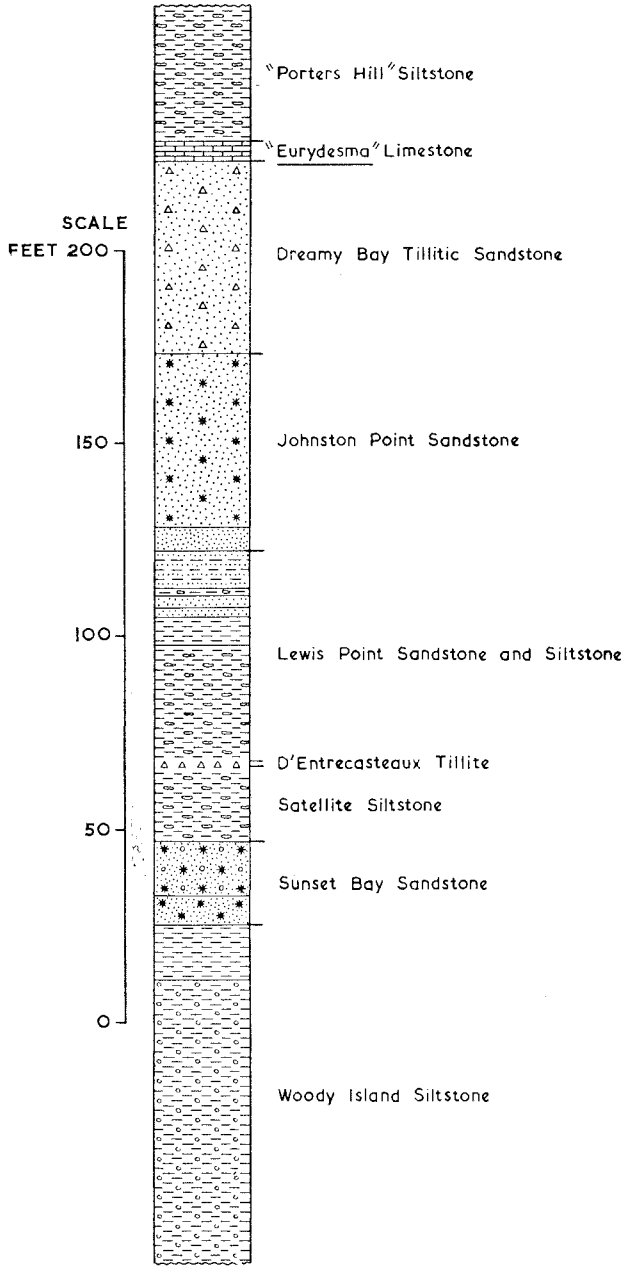

FIG. 2.—Columnar section of Permian on Woody Island.

West of the fault, the island consists entirely of a dark-grey siltstone with large pyritic concretions, large lenticular calcareous concretions and numerous glendonites, as large single crystals, stars of four large crystals or as rosettes of numerous small crytals. One single crystal measured was 20 cms. long. Fossils are rare but include *Eurydesma cordata* and others. This is included as a member of the Woody Island Siltstone on the grounds of extreme lithological similarity but is considered to lie below the lower member exposed at the eastern end of the island because no glendonites occur there.

Sunset Bay Sandstone

The Sunset Bay Sandstone is that formation of sandstone, 21 feet in thickness, which overlies the Woody Island Siltstone and is overlain by the Satellite Siltstone as exposed on the northern side of Woody Island. Fossils are rare but include *Eurydesma cordata*. The formation is Permian, probably Sakmarian. Sunset Bay, after which the formation is named, is on the southern side of Woody Island.

This formation consists of two units, both of which are well-sorted, fine-grained sandstones with a few erratics of granite and quartzite. The grains are angular. Quartz is the only mineral identified macroscopically in the lower unit and quartz and feldspar are present in the upper unit. Bedding in both is thick and cross-bedding occurs in the lower member. Both are grey, or mottled dark and light-grey in colour. Glendonites are present in both units and one from the lower unit is illustrated (plate I). The higher unit contains pyrite concretions but these are not large. In the lower unit worm tracks and burrows are common but macrofossils are rare, only *Eurydesma cordata* being collected.

Satellite Siltstone

The Satellite Siltstone is that formation of fossiliferous siltstone 20 feet thick, overlying the Sunset Bay Sandstone and overlain by the D'Entrecasteaux Tillite on the northern shore of Woody (or Satellite) Island. It contains many fossils but especially noticeable is *Stenopora tasmaniensis*. It is Permian, and probably Sakmarian, in age.

The Satellite Siltstone is a richly fossiliferous siltstone with thick bedding, good sorting and rare erratics. Quartz and feldspar are present and the siltstone is a medium dark-grey (N 4) in colour and has a blocky fracture. The most noticeable feature of the formation is the abundance of fossils which form at least 20 per cent of the rock and, on the southern shore, are preserved as the original skeletons. Dominant in numbers among these is *Stenopora tasmaniensis* which forms dense mats at a slight angle to the bedding. The ramose colonies are markedly oriented, the main direction being to the north-east, as if they had been oriented by currents flowing from the south-west. Other fossils are listed below:

Bryozoa.

Stenopora tasmaniensis	very common
Stenopora spp.	v.c.
Fenestella dispersa	c.
Fenestellidae	v.c.
Streblotrypa marmionensis	rare

Brachiopoda.

Strophalosia spp.	v.c.
Grantonia hobartensis	few to common
"*Martiniopsis*" sp.	few
Spiriferidae	common

Mollusca.

Merismopteria macroptera	rare
Deltopecten sp.	common
Mourlonia sp.	common

Echinodermata.

Calceolispongia sp.	few disarticulated columnals
Jimbacrinus sp.	radials, basals and brachials

D'Entrecasteaux Tillite

The D'Entrecasteaux Tillite is that formation of tillite six inches thick underlain by the Satellite Silstone and overlain by the Lewis Point. Sandstone and Siltstone as exposed on the northern shore of Woody Island. Fossils are rare and are mainly spiriferids. The age is Permian and probably Sakmarian. The formation is named after the D'Entrecasteaux Channel, in which Woody Island occurs.

This formation is a medium-grained sandstone with poor sorting and angular to sub-angular grains. Quartz is the main mineral in the matrix but feldspar is also present. Sub-rounded to facetted erratics of sandstone, schist and slate are common. The cement is kaolinitic, the colour dark bluish grey and the bedding thick. Spiriferids are rare and are essentially the only fossils.

Lewis Point Siltstone and Sandstone

The Lewis Point Siltstone and Sandstone is that formation of siltstone and sandstone 54 feet thick underlain by the D'Entrecasteaux Tillite and overlain by the Johnston Point Sandstone as exposed along the northern shore of Woody Island. It is fossiliferous, the fossils including *Grantonia hobartensis*, *Mourlonia* sp., *Platyschisma ocula* and *Eurydesma* sp. It is Permian, and probably Sakmarian, in age. Lewis Point is on the northern shore of Woody Island.

This formation consists of a rough alternation of siltstone and sandstone. The lowest member is a coarse fossiliferous siltstone composed of quartz and feldspar in a clayey matrix with a few rounded erratics up to 8 cms. in diameter of claystone, quartz and granite. The beds are thick and the fracture is blocky. Cross-bedding and slump structures on a very small scale are present. The siltstone is light blue-grey and fossils are common. The fossils include *Grantonia hobartensis* and other spiriferids, *Stenopora* sp., *Eurydesma* sp., *Mourlonia* sp. and *Fenestella* spp. in the lowest 11 feet. After an unfossiliferous section to 23 feet there are four feet of fossiliferous siltstone with *Neospirifer* spp., *Stenopora* sp., *Platyschisma ocula* (rare), large aviculopectinids, and *Eurydesma* sp. The top three feet of siltstone contain many fenestellids, "*Martiniopsis*" spp. and crinoid columnals.

This unit is followed by a greenish grey (5 GY 6/1), micaceous, fossiliferous siltstone without erratics and with lenticular clayey concretions up to three feet in diameter. This siltstone has thick bedding and

poor fissility. The fossils which are few in number are mainly small pelecypods including *Parallelodon costellata* (McCoy), *Nuculana darwini* (de Koninck) and *Edmondia* sp. The strophomenid *Streptorhynchus* sp. is also present. Small rectangular carbonaceous fragments are common but their relationship is unknown.

A fine micaceous, white or yellowish sandstone follows. The sorting is good and both quartz and feldspar are present. The cement is clayey and the sandstone is friable where exposed. The bedding is thick. The bounding surfaces with adjacent units are irregular, suggesting penecontemporaneous erosion. Pelecypods and *Fenestella* occur in patches.

Three feet of fine-grained, well-sorted quartz sandstone, of bluish-grey colour, follows. Bedding is very thin but the rock splits massively. Occasional worm tracks are the only fossils. A well-sorted fine-grained, sandstone with sub-angular fragments of quartz and feldspar in a clayey matrix is the next unit. It is light grey in colour and has rare erratics of quartzite and slate. Pentagonal crinoid columnals are common in this member and are associated with pelecypods and numerous *Stenopora* prob. *tasmaniensis*. It is thickly bedded. These last two rock types alternate for the topmost 10 feet of the formation.

Johnston Point Sandstone (Here renamed Alonnah Sandstone (see footnote page 220.)

The Johnston Point Sandstone is that formation of glendonitic sandstone 51 feet thick overlying the Lewis Point Siltstone and Sandstone and underlying the Dreamy Bay Tillitic Sandstone on the northern shore of Woody Island. Fossils are very common and include *Eurydesma cordata, Strophalosia clarkei* and *Calcitornella stephensi*. It is Permian, and probably Sakmarian or early Artinskian, in age.

The lower member is a spiriferid sandstone of medium to fine grain-size, with poor sorting and erratics forming up to 15 per cent of the rock. The erratics are up to 8 inches in diameter and include quartz, quartzite, granite, schist, sandstone and slate. The matrix consists of angular to sub-angular grains of quartz (about 60 per cent of the rock) and feldspar. The rock is grey and has thick bedding. The cement is mainly clayey but may be calcareous in part. Fossils, as the original shells, form up to 25 per cent of the rock and are mainly spiriferids such as *Trigonotreta stokesii, Grantonia hobartensis* and *Neospirifer* spp. Other fossils include Aviculopectinidae, *Eurydesma cordata, Merismopteria macroptera, Strophalosia* spp. and *Stenopora* sp. Although many of the fossils are broken, some are complete but they lack orientation.

The higher member is mineralogically and texturally very similar. It is light olive grey (5Y6/1) when fresh but weathers brownish yellow. The bedding is thick but due to the abundance of fenestellids some parts are laminated, and others thinly bedded. Arrowhead markings, representing infilled worm burrows, are common. Fossils are very common and are predominantly productids but fenestellids are also common. The fossils include: *Calcitornella stephensi, Stenopora* sp., *Polypora ampla, Polypora* spp., other fenestellids, ? *Anidanthus* sp., "*Martiniopsis*" sp., *Neospirifer* spp., *Grantonia hobartensis* and other spiriferids, *Eurydesma cordata, Merismopteria* sp., *Aviculopecten* sp., *Platyschisma ocula, Mourlonia* sp. and pentagonal crinoid columnals. *Strophalosia clarkei* and

other *Strophalosia* spp. are very common. Ostracodes are rare as also are plant fragments. *Spiriferina duodecimcostata, Dielasma* sp. and *Stutchburia* sp. are also present.

Glendonites occur in this formation as external moulds on the southern side of the island.

Dreamy Bay Tillitic Sandstone

The Dreamy Bay Tillitic Sandstone is that formation of poorly-sorted, erratic-rich sandstone 50 feet thick resting on the Johnston Point Sandstone and overlain by the "*Eurydesma*" Limestone as exposed on the northern shore of Woody Island. Fossils include *Stenopora tasmaniensis* and *S. johnstoni*. Its age is Permian and probably Sakmarian or early Artinskian. Dreamy Bay is on the northern side of Woody Island.

This sandstone is medium-grained, dark-grey, thickly bedded and poorly sorted. The grains and erratics in it are angular fragments of granite, limestone, quartzite and quartz. Both quartz and quartzite are very common in the erratics and in the matrix. Fossils are also abundant, haphazardly arranged and the bryozoans frequently broken. The texture suggests quite strong current conditions. The fossils include large sheets of *Stenopora johnstoni* and branches of *S. tasmaniensis*. The original shell material is usually preserved.

"Eurydesma" Limestone

No formal definition of this unit is offered here as it is hoped shortly to publish a detailed account of the stratigraphy of Maria Island with formal definitions of the units including the "*Eurydesma*" Limestone.

Although this unit is only five feet thick, it is an important one for correlation. It is a limestone, composed of fine-grained calcite as a matrix with rare, small erratics. Crinoid columnals and calyx plates are common. It is medium-grey (N 5) in colour and the fossils which are of all sizes, are extremely common. *Stenopora tasmaniensis* is the main form present but *S. johnstoni* also occurs as also does *Eurydesma cordata*. *Calcitornella stephensi* is revealed in thin sections. It is a thick-bedded bryozoal, crinoidal limestone. It is correlated with the "*Eurydesma*" Limestone of Maria Island on the evidence of the *Stenopora* spp. and *Eurydesma cordata* as well as on lithology. It was probably formed in deeper water than the limestone on Maria Island. It is also correlated with the Permian Limestone at Lilydale on the east Tamar, on the grounds of the presence of *Calcitornella stephensi*.

"Porters Hill" Siltstone

The final formation measured east of the fault is a fossiliferous siltstone composed of sub-angular grains of quartz and feldspar in a clayey matrix. It weathers to a buff colour and consists of alternating thickly-bedded and thinly-bedded to laminated layers. Erratics are few but fossils are abundant and include bryozoa in sufficient numbers to cause lamination of the rock.

The fossils include *Keeneia platyschismoides, Eurydesma cordata,* &c. This formation is correlated with the beds in the cliffs above the shoreline at Porters Hill, Sandy Bay, the Porters Hill Beds of Johnston, 1888, and the Bundella Mudstone of the Mt. Nassau section on the evidence of lithological similarity and the occurrence common to all three of *Keeneia platyschismoides, Eurydesma cordata,* and abundant ostracodes.

Structural Geology

The beds dip slightly west of north at about 8° and are intersected by a fault striking about 335° M near the western end of the island. The fault downthrows to the north-east by at least 250 feet. Jointing at 335° M and 45° M occurs close to the fault with jointing at 75° M and sheet jointing at 45° M on the western tip of the island. A sketch section, fig. 1, illustrates the structure.

Correlations and Age

The evidence for correlation within Tasmania of the formations exposed on Woody Island has been given where appropriate in the preceding text. However, the correlation of these formations with formations outside Tasmania has not been considered, and it is useful to do so here.

The species important for correlation are the foraminifera *Calcitornella stephensi,* the bryozoa *Stenopora johnstoni* and *S. tasmaniensis* and the gastropod *Keeneia platyschismoides. Calcitornella stephensi* occurs (Crespin, 1947, pp. 11-12) in New South Wales in the Lower Marine Group in the Lochinvar, Allandale and Farley Stages. However, Osborne (1949, p. 222) records it only from the Allandale Stage, although from his text (p. 214) it is clear that the actual horizon is that described by Chapman and Howchin (1905) from Pokolbin which is at the base of the Rutherford Stage. At this level foraminiferal limestones occur and it is tempting to correlate the "*Eurydesma*" Limestone on Woody Island with these limestones in New South Wales, and such a correlation would certainly not be far wrong. It is probable on the evidence of *Calcitornella* that the "*Eurydesma*" Limestone is equivalent to part of the Lower Marine Group and most probably to the lower part of the Rutherford Stage. Crockford (1951, p. 110) records *Stenopora johnstoni* from the Allandale and Rutherford Stages and Osborne (1949, p. 222) records *S. tasmaniensis* from the Rutherford Stage. The occurrence of these two species together with *Calcitornella* in the "*Eurydesma*" Limestone of Woody Island strongly suggests correlation with some part of these two stages. *Keeneia platyschismoides,* here recorded for the first time from Tasmania, is restricted in New South Wales to the Lower Marine Group and Osborne records it only in the Allandale Stage. In Tasmania it is found at Woody Island in the beds above the "*Eurydesma*" Limestone, at Porters Hill, Sandy Bay, in the beds just a few feet above high-water mark, and in a road cutting half a mile beyond Rathbone's Lime Kiln on the Lyell Highway, in the Bundella Mudstone. This suggests that these beds are about equivalent to the top of the Allandale Stage, and are certainly equivalent to a part of the Lower Marine Group.

In Western Australia the range of *Calcitornella stephensi* is from the Callytharra Limestone to the Quinannie Shale but it is commonest in the Callytharra Limestone (Teichert, 1952, and Crespin, 1947). Other fossils from Woody Island which also occur in Western Australia are *Streblotrypa marmionensis,* here recorded for the first time from Tasmania, *Calceolispongia* sp. and *Jimbacrinus* sp. The presence of these forms indicates that even at an early stage in the Permian a relationship existed between the faunas of Western Australia and Tasmania. *Streb-*

lotrypa marmionensis occurs over a wide stratigraphic range in Western Australia as also do *Calceolispongia* spp. *Jimbacrinus* sp. has been recorded from only one area in Western Australia and it is too early to know if it has any stratigraphic value. The "*Eurydesma*" Limestone of Woody Island is therefore most likely equivalent to the Callytharra Limestone of Western Australia but may be as young as the Quinannie Shale. According to Teichert (1952, p. 122) the Callytharra Limestone is Artinskian in age but probably close to the base of the Artinskian, so that it is possible that the underlying formations at Woody Island are Lower Artinskian or more probably Sakmarian.

Finally, it might be emphasised that the "*Eurydesma*" Limestone of Woody Island is *not* equivalent to the Berriedale Limestone of the Hobart district and Maria Island but is much lower in the section.

SUMMARY

The Lower Permian section on Woody Island consists of the Woody Island Siltstone at the base followed by the Sunset Bay Sandstone, the Satellite Siltstone, the D'Entrecasteaux Tillite, the Lewis Point Sandstone and Siltstone, the Johnston Point Sandstone, the Dreamy Bay Tillitic Sandstone, the "*Eurydesma*" Limestone and the "Porters Hill" Siltstone. The total thickness of the section is about 330 feet. The "*Eurydesma*" Limestone is correlated with the limestone near the base of the Rutherford Stage of the Lower Marine Group of New South Wales and the Callytharra Limestone of Western Australia and the whole section on Woody Island is considered to lie within the time range of the deposition of the Lower Marine Group of New South Wales. The formations below the "*Eurydesma*" Limestone may be Sakmarian while this formation and the higher one are probably Artinskian.

Glendonites occur in the Woody Island Siltstone, the Sunset Bay Sandstone and the Johnston Point Sandstone.

The Permian section is cut by a north-westerly trending fault with a throw of at least 260 feet down to the east.

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LOCALITY INDEX

	Internat. Grid. Reference K/55 Quadrangle		S. Lat.	E. Long.
Lilydale	Pipers Riv.	31	41° 14′	147° 13′
Maria Island	Maria Is.	77	42° 35′	148° 4′
Sandy Bay	Hobart	82	42° 54′	147° 20′
Woody Island	Dover	94	43° 19′	147° 13′

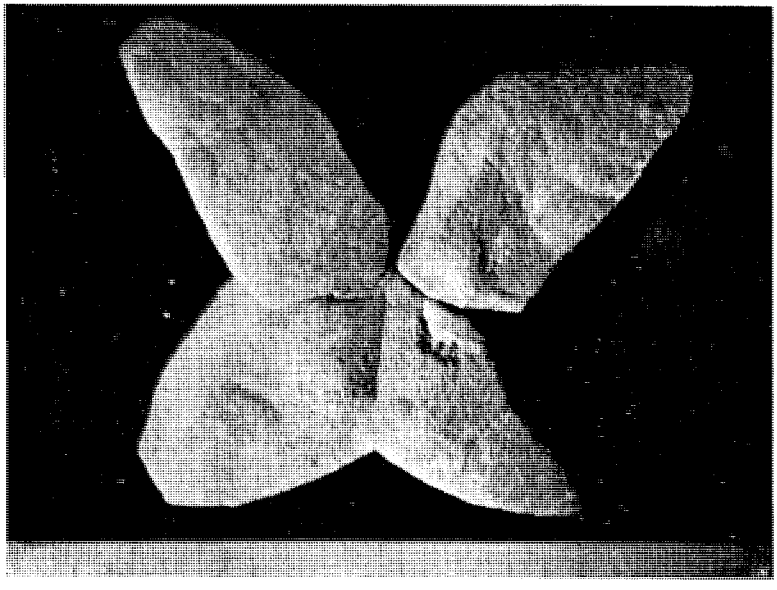

PLATE I.—Photograph of glendonite.